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ABSTRACT

Variables and conditions that influence the learning of computer-presented expository text were investigated in this study, in which on-screen underlining was used as a learning aid to increase "mindful" processing of information. The effects of three intervening variables--amount of invested mental effort (AIME), learning style, and perceived task difficulty (PTD)--were examined for the 27 graduate and undergraduate students who served as subjects. They were divided into three groups, and three learning conditions were designed: self-generated underlining, program-provided underlining, and optional control of the underlining. Analyses of the data indicated that: (1) there was no aptitude treatment interaction effect between learning style and treatment; (2) intentional learning on the factual items, which were underlined for the program-provided underlining group, did not lead to better performance; (3) compared AIME was a better predictor for reading achievement than the AIME; (4) perceived task difficulty had a positive relationship with time and the AIME; and (5) "help" on the underlining did not facilitate reading performance in the optional control group. There were no significant differences in performance among the three treatment groups. Areas for further research are suggested, and tables of supporting data and a 33-item bibliography are appended. (MES)

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Effects of Using On-Screen Learning Aids and Reading Performance

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Running head: ON-SCREEN LEARNING AIDS

Abstract

This study was designed to investigate variables and conditions that directly influenced the learning of computer-presented expository text. On-screen underlining was used as a learning aid to increase a learner´s "mindfully" processing information. Three learning conditions were designed: self-generated underlining, program-provided underlining, and optional control of the underlining. In addition, this study also examined the effects of intervening variables such as learning style, amount of invested mental effort (AIME), perceived task difficulty (PTD), time-on-task (TIME), compared AIME with others after learning (compared AIME), self-judged reading ability, and amount of experience with computers. AIME referred to the "number of nonautomatic mental elaborations applied to a unit of material" (Saloman, 1984). Twenty seven subjects participated in this study. Stepwise multiple regression analysis indicated that compared AIME, learning style, and time-on-task are the best predictors of reading performance. There were no significant differences of the reading performance among self-generated underlining group, program-provided underlining group, and the optional-control group.

Effects of Using On-Screen Learning Aids and Reading Performance

In the 1960s, some writers claimed that print was a dying medium (Balajthy, 1986). Print would be totally replaced by electronic text (Rosch, 1980). However, research has indicated that subjects reading material from a computer not only spent more time than subjects reading the same material from print (Muter, Latremouille, & Treuniet, 1982), but also performed worse (Happner, Anderson, Farstrup, & Weiderman, 1985). Therefore, most of the educators believed that the computer will never replace print as a delivery medium to present information. Nevertheless, text presentation still plays an important role in all types of computer-based instructional (CBI) lessons. Even complexity, sophistication, and the amount of presented information in each lesson may vary. It is important then, to find out what factors cause the differences mentioned above, and how reading performance on computers can be improved. A number of factors that influenced reading performance on computers have been identified. These include the resolution of the computer screen display, the type or the spacing of the font (Merrill, 1982), etc. In addition to these surface features, one possible explanation of the differences in reading performance is that while learning from a computer, the computer does not provide learners with the options to apply typographical or organizational learning aids to facilitate their information acquisition. Therefore, information processing is shallower (Craik & Lockheart, 1972), and memory trace is weaker than reading from print. Thus, in this study, it was my intention to investigate whether reading performance can be improved by making on-screen application of selected learning aids easily accessible to the learners.

There are many techniques which have been suggested for aiding text comprehension, such as underlining key concepts (Richards & August, 1975), adding an advance organizer (Ausubel, 1968), taking notes (Pepper & Mayer, 1986), or summarizing (Brown & Day, 1983). In the present study, underlining was selected as a learning aid for its ease of application in computer-based text and time efficiency. In addition, research indicated that while underlining, students seemed to concentrate more on the tasks and recognized/recalled more about these intentionally learned tasks later (Coles & Foster, 1975; Dosher & Russo, 1976; Glynn & DiVesta, 1979; Richards & August, 1975).

Researchers have used various cognitive approaches to explain this phenomenon. Cashen & Leicht(1970) stated that "making materials conspicuous by underlining serves the function as presenting the material as an advance organizer." Rigney

(1978, 1980) suggested that a learning aid such as underlining can make learning become more "conscious." Hyde & Jenkins (1969) indicated that intentional learning has better effects on word recognition than incidental learning does. Other researchers (Mayer, 1975, 1984; Rothkoph, 1970; Wittrock, 1974) have explained this phenomenon using the "generative effect", which means that by underlining, a learner is able to relate actively the material to prior knowledge.

This study was also designed to investigate the effects of the following intervening variables: AIME, perceived task difficulty, and learning style.

Amount of Invested Mental Effort (AIME)

It is generally perceived that a major advantage of CBI programs is their great potential to adapt systematically to learners' individual needs and abilities. In these programs, learners may control the pace, sequence, and depth of study (Gay, 1986). However, these programs have not yet led to optimal performance (Snow, 1983; Crono & Mandinach, 1983). Saloman (1985) proclaimed that a computer's source of success does not lie only in its attributes, but also in how "mindfully" (amount of effort invested) learners come to handle them. The term amount of invested mental effort (AIME), defined as the number of nonautomatic elaborations applied to a unit of material, was used to indicate the degree of "mindfulness" (Saloman, 1984). In the present study, it was hypothesized that students who generate underlining themselves after reading would invest greater amounts of mental effort, and outperform subjects receiving underlining passively from the program. In addition, the AIME was also influenced by the perceived task difficulty (PTD). When facing a complex, ambiguous, incongruent, or novel stimulus, learners usually spent more time on the task, and reported that more effort was invested (Anderson, Reynolds, Schallert, & Goetz, 1977; Bobrrow & Collins, 1975; Lepper, 1983; Pittman, Beggiano, & Ruble, 1983).

Learning Style

Learning style referred to how learners perceive, interact with, and respond to the learning environment (Keefe, 1979). Kolb (1981) proposed an experiential learning model which has integrated the abstract and concrete as well as the active and passive characteristics to explain adult learning processes. He conceived learning as a four stage cycle. In order to obtain new experiences, the learner needs to first, actively involve in new experience--concrete experience (CE); secondly, reflect on the experience from various perspectives--reflective observation

(RO); thirdly, formulate abstract concepts into logically sounded theories--active conceptualization (AC); and finally, be able to apply these new concepts and form generalizations--active experiment (AE). Although this model is cyclical and progressive in nature, Kolb and others have found that highly individualized styles of information utilization are developed on each of these bipolar dimensions.

According to aptitude-treatment interaction (ATI) effect, individuals with different aptitudes learn differently under different situations (Cronbach & Snow, 1977). Thus, it was hypothesized that subjects with an active type of learning style would learn better under self-generated learning aid condition, while subjects with a passive type of learning style would learn better under program-provided situation.

In summary, this study was designed to investigate the following hypotheses:

(1) Self-generated underlining leads to better reading achievement than program-provided underlining.

(2) Active type of learners benefit more in the self-generated underlining condition while passive type of learners benefit more in the program-provided underlining condition.

(3) AIME, PTD, and learning style are valid determinants in predicting the reading performance.

(4) Subjects in the program-provided group should perform better on the test items that are relevant to the underlines provided in the treatment.

Methods

Subjects

Posters asking for participants were posted at the University of Minnesota. Twenty seven students (thirteen undergraduate and fourteen graduate) participated in this study. Each subject was paid $5 for their participation.

Design

A completely randomized blocking design was used in this study. The blocking variable was learners' learning styles. The independent variable consisted of the following three levels: self-generated underlining, program-provided underlining, and

optional control of underlining. In the self-generated underlining group, underlining of the prose passages was generated by the learners. In order to proceed to the next screen, learners had to underline at least one word. There was no limit to the amount of allowed underlining. In the program-provided underlining group, underlining of the prose passages was provided by the experimenter. Finally, in the optional-controlled group, learners were asked to underline the key words by themselves first. However, if they could not figure out the key words or wanted to compare their own underline with the experimenter's, they were allowed to press a "HELP" key to have the word underlined for them. The treatments were parallel in all respects except in manipulation of the independent variable--control of underlining.

The dependent variables were the correct scores on the posttest and time-on-task.

Learning materials.

Each of the three treatment groups received the following materials on the computer: (a) An introductory lesson explaining the objectives of the program and the length of each passage; (b) pages of directions on how to use the function keys to proceed through the lessons. In addition, demonstration on how to use the underlining key was given to the subjects in the self-generated and program-provided groups. Subjects in the optional-control group were also given the instructions on how to use the "HELP" key; (c) a practice unit, different in each group, familiarizing the subjects with the special keys and screen display; and (d) two text passages presenting the information to be learned.

A paragraph of text on "Amish" people (Brozo, Schmelzer, & Andrews, 1984) was used as the practice text for all the groups. Two expository test passages were given to the subjects. The first passage, "Ancient Greek Poets", was adopted from the Nelson-Denny Reading Test Form A (1960). It describes how the poetic form has changed during the six hundred years since Homer's death. This passage had 684 words in 31 sentences and nine paragraphs, and was presented in six computers screens. In the posttest, eight questions were adopted from the original test. The two remaining items were written by a panel of three graduate students. The second passage "Tsunami", i.e. tidal waves, was adapted from the book "Setting the Pace" (Brozo, Schmelzer, & Andrews, 1984), and describes the formation of sea waves. This passage had 758 words in 33 sentences and 15 paragraphs, and was presented in eight computer screens. The original 10 test items were partially revised by the experimenter

and a panel of three graduate students.

The design of the screen display followed the principles suggested by Allesi & Trollip (1985). The text was in a form of 60-columned, double-spaced, and upper and lower cases screen display. Each screen had 11 text lines in maximum. When a screen could not contain a complete paragraph, then this paragraph was moved to the next screen. Underlining used in the program-provided group representing the macrostructure of the text, was developed following Kinstch & Van Dijik's model (1978). Each screen had only one central idea underlined. This information was tested on the posttests later on. To eliminate the possible confounding effects, the treatments were designed so they did not allow the subjects to review the previous screens, take notes or erase the unwanted underlines.

Measures

The following measures were used in this study:

Learning style. Subjects were tested for their learning styles using Kolb's Learning Style Inventory (1985). This questionnaire includes twelve items and measures learners by using two bipolar variables: abstract conceptualization (AC)/concrete experience (CE) and active experimentation (AE)/reflective observation (RO). The internal reliability measured by Cronbach's α. For AE, $\alpha = .82$; for RO, $\alpha = .73$. Ipsative scaling was used in this inventory. Generally, a subject's learning style is identified by the combination of scores on both AC-CE vs. AE-RO. However, in this study, only the scores on AE/RO were used because it was assumed that the effects of on-screen underlining directly related to learners' preference for learning through active generating or passive observing the learning aid.

Posttests. Five factual and five comprehensive multiple choice test items were designed for each passage to test reading retention. For each text passage, the posttest was divided into two subsets: (a) a relevant subset containing five factual items related to the content of the program-provided underlining. (b) The other subset dealing with comprehensive items not covered by underlining. The factual items were designed to test if intentional learning would produce better performance.

Self-report questionnaire. This questionnaire was designed to measure each learner's perception on the difficulty and interest levels of the passages, the AIME, the degree of concentration, and the AIME compared with other learners, etc. Subjects were asked to respond to statements such as "This is a difficult passage," "I tried hard to understand this passage," "

I concentrated while reading the passage," "I think that other readers must have tried harder than I did to understand this passage." Each item was scored on a 5-point Likert scale.

Procedure

The study was conducted in a computer lab administered by the College of Education. Two weeks before the study, subjects were tested to determine their learning styles, then randomly assigned to three treatment groups. On the first week, the subjects came to the computer lab at their own selected time. Before reading the on-screen prose passages, subjects filled out a demographic questionnaire, which asked them to indicate their perceived reading level (good, fair or poor), time spent on reading per week, and amount of experiences on computers. They were then asked to read the learning materials, presented by IBM XTs with color monitors. Subjects were allowed sufficient time to complete the reading. Then they were asked to stop and answer four questions on a separate printed page. These questions asked the subjects to evaluate the difficulty and interest levels of the passage and their AIME and concentration while reading the passage. Then a 10-item quiz was given on the computer. After the quiz, the subjects were asked to stop again to judge whether the passage was more difficult than they thought before the quiz, in order to decide if achievement on the quiz had influenced the judgement of the task difficulty. Subjects also were asked if they would like to learn under the same learning aid condition or not. Afterwards, the subjects read the more technical passage "Tsunami." The same procedures were administered again. After the second quiz, subjects compared their own AIME with other people's and compared the difficulty levels of these two passages.

Results and Discussion

The means and standard deviations of correct responses to the two types of posttest items and the combined scores are presented in Table 1.

Insert Table 1 Here

Although the mean scores on the self-generated group were slightly higher than the other two groups, oneway analysis of variance on the types of test items revealed a nonsignificant effect for: factual items, $F(2,27)=1.05$, $p < .16$, comprehensive test items, $F(2,27)=.61$, $p < .25$, and the combined scores, $F(2,27)= 1.36$, $p < .17$. These results do not support the

hypothesis that self-generated underlining group would perform better than the other two groups.

The 2 (learning style) × 3 (treatment) multivariate analysis of variance revealed nonsignificant effects for learning style, $F(1,27)=4.27$, and treatment $F(2,27)=4.19$, and learning style and treatment interaction $F(2,27)=3.08$. These results suggest that ATI effect does not exist between learning style and treatment.

In the optional control group, asking for more help resulted in a worse performance ($r=-.41$, $P < .01$). This result may be explained by the "interference" effect (Windfield & Brynes, 1981).

Intercorrelations, means, and standard deviations of the intervening variables are displayed in Table 2.

Insert Table 2 Here

Learning style was not significantly correlated with any of the other variables except the amount of experiences working with computers. The significant negative correlation ($r=-.48$, $p < .01$) between learning style and experiences with computer indicated that most of the computer users possessed passive observing (or reflective observation) type of learning style, which is inconsistent with the theory of career development reported by Kolb that computer experts usually scored higher in the active experimentation dimension (1985). The perceived task difficulty is weakly but significantly correlated with the AIME ($r=.27$, $p < .01$), and time-on-task ($r=.46$, $p < .01$). These results are consistent with the literature which suggested that if the learners perceived the tasks as difficult, they would spend more time on the task and reported that a greater amount of efforts are invested. Finally, the significant correlation between perceived task difficulty and compared AIME ($r=.55$, $p < .01$) suggests that when learners perceived a task as difficult, they will have a tendency to think that they have tried harder than other learners in understanding the text.

To investigate further the pattern of correlations among the variables, a multiple regression analysis was computed with reading performance as the criterion variable. The results are presented on Table 3.

Insert Table 3 here

The variables were entered into the regression equation in the fixed order of compared AIME, learning style, time-on-task, reading ability, computer user and the AIME. The results of this analysis, which are presented in Table 3, indicate that compared AIME, learning style, and time-on-task are the best predictors of reading performance.

Summary and Conclusion

In summary, there were three major findings from this study: (1) ATI effect between learning style and treatment does not exist. (2) The hypothesis that intentional learning on the factual items, which were underlined in the program-provided underlining group, would lead to better performance was not supported. (3) Compared AIME is a better predictor for the reading achievement than the AIME. (4) Perceived task difficulty has positive relationship with time and the AIME. That is, when the learners perceived the task as difficult, they spent more time on the task and reported more effort have been invested. (5) In the optional control group, "help" on the underlining does not facilitate the reading performance.

The insignificant results of the study may have caused by the following factors: (1) the sample size was too small to make reliable conclusions. There were only nine subjects in each treatment. In the learning style vs. treatment interaction analysis, subjects in each cell ranged from three to five. (2) The reliability of the test items were not high: Nelson-Denny Reading Test was originally administered as a timed test. In this study, students were given sufficient time to accomplish the text reading. Therefore, the reliability of the test items has decreased from .77 to .45. (3) No delayed retention test was given to the subjects. Thus, the possibility that self-generated learning would lead to better retention was not tested.

There are two suggestions for further study: (1) Provide other learning aids such as summary and adjunct questions, because underlining facilitates only shallow information processing, which will not foster reading comprehension and retention as summary and adjunct questions will. (2) Make the best use of the computer: collect the data on learners' underlining prototypes and compare those with the reading experts. This can help us to understand the quality differences of information encoding process between experts and good vs. poor readers.

Table 1

Mean and Standard Deviation of Correct Responses as a Function of Test Item Type and Treatment

	Treatment					
	Self-Generated		Program-Provided		Optional	
Types of Test Items	M	SD	M	SD	M	SD
Factual items	8.22	1.39	7.56	1.33	7.67	1.41
Comprehensive items	7.44	0.88	7.22	1.64	6.56	0.88
Combined score	15.67	1.94	14.78	2.39	14.22	2.05

Table 2

Intercorrelation Matrix Among the Intervening Variables

Variables	1	2	3	4	5	6	7
1. Learning style		-.30	.06	.37	-.03	-.24	-.48*
2. AIME			.27*	.11	.22	.42	.33
3. PTD				.46*	.55*	-.27	.13
4. Time-on-task					.08	.11	-.07
5. Compared AIME						-.02	.08
6. Reading ability							.11
7. Experience with computers							
MEAN	4.00	7.00	5.89	1205.52	2.33	1.37	1.30
SD	12.60	1.73	1.63	860.76	1.24	0.69	0.54

Note: N=27. * $p < .01$.

Table 3

Summary of Multiple Regression Analysis With Reading Performance as the Criterion Variable

Variables	F	Standardized B Value	Increase in R^2
1. Compared AIME	6.35	.45	.20*
2. Learning style	5.32	.65	.22*
3. Time-on-task	4.82	.72	.10*
4. Reading ability	3.46	.72	.00
5. Experience with computers	2.67	.72	.00
6. AIME	2.19	.73	.00

Note. N=27. * $p < .01$.

Bibliography

Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T. (1977). Frameworks for comprehending discourse. American Educational Research Journal, 14, 367-382.

Alessi, S. M., & Trollip, A. R. (1985). Computer-based instruction: Methods and development. Prentice-Hall, Inc., NJ: Englewood Cliffs.

Ausubel, D. P. (1968). Education psychology: A cognitive view. New York: Holt, Rinehart & Winston.

Balajthy, E. (1986). Microcomputers in reading and language arts. Prentice-Hall, Inc., NJ: Englewood Cliffs.

Borrow, D. G., & Collins, A. (1975). Representation and Understanding: Studies in cognitive science. New York: Academic Press.

Brown A. L., & Day, J. D. (1983). Macrorules for Summarizing Texts: The Development of Expertise. Journal of Verbal Learning and Verbal Behavior, 22, 1-14.

Brozo, W, G., Schmelzer, R. V., & Andrews, D. A. (1984). Setting the Pace, Bell & Howell Co., Columbus, Ohio.

Cashen, V. M., & Leicht, K. L. (1970). Role of the isolation effect in a formal educational setting. Journal of Educational Psychology, 61, 484-486.

Craik, F. I. M., & Lockheart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

Coles, P., & Foster, J. (1975). Typographic cuing as an aid to learning from typewritten text. Programmed Learning and Educational Technology, 12(2), 102-108.

Cronbach, L. J., & Snow, R. E. (1977). Aptitudes and instructional methods: A handbook for research on interactions. New York: Irvington.

Crono, L., & Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation. Educational Psychologist, 18(2), 88-108.

Dosher, B. A., & Russo, J. E.. (1976). Memory for internally generated stimuli. Journal of Experimental Psychology: Human

Learning and Memory, 2(6), 633-640.

Gay, G. (1986). Interaction of learner control and prior understanding in computer-assisted video instruction. Journal of Educational Psychology, 78(3), 225-227.

Glynn, S. M., & DiVesta, F. (1979). Control of prose processing via instructional and typographical cues. Journal of Educational Psychology, 71(5), 494-603.

Heppner, F. H., Anderson, J. G. T., Farstrup, A. E., & Nelson, H. W. (1985). Reading performance on a standardized test is better from print than from computer display. Journal of Reading. 321 -325.

Hyde, T. S., & Jenkins, J. J. (1969). Differential effects of incidental tasks on the organization of recall of a list of highly associated words. Journal of Experimental Psychology, 82, 472-481.

Keefe, J. W. (1979). (Eds.) Student Learning Styles: Diagnosing and Prescribing Programs, Reston, Va.: National Association of Secondary School Principals.

Kintsch, W., & VanDijk, T. A. (1978). Toward a model of text comprehension and production. Psychological Review, 85(5), 363 -394.

Kolb, D. A. (1981). Disciplinary inquiry norms and student learning styles: Diverse pathways for growth. The Modern American College, Chickering A. (Eds.), San Francisco: Jossey -Bass.

Lepper, M. R. (1983). Extrinsic reward and intrinsic motivation: Implications for the classroom. In J. M. Levine, & M. C. Wand (Eds.) Teacher and student perceptions: Implications for learning (pp. 281-317). Hillsdale, NJ: Erlbaum.

Mayer, R. E. (1975). Information processing variables in learning to solve problems. Review of Education Research, 45, 525-541.

Mayer, R. E. (1984). Aids to text comprehension. Educational Psychologist, 19, 30-42.

Merrill, P. F. (1982). Displaying text on microcomputers. In Jonassen, D. H. (Eds.) The technology of text: Principles for structuring, designing, and displaying text.Educational Technology Publication, NJ: Englewood Cliffs.

Muter, P., Latremouille, S. A., & Treurniet, W. C. (1982). Extended reading of continuous text on television screens. Human Factors, 24(5), 501-508.

Nelson-Denny Reading Test (1960). Chicago, Ill: Riverside Publishing Co.

Pepper, R. J., & Mayer, R. E. (1985). Generative effects on note-taking during science lectures. Journal of Educational Psychology, 78(1), 34-38.

Pittman, T. S., Boggiano, A. K., & Ruble, D. N. (1983). Intrinsic and extrinsic motivational orientations: Limiting conditions on the undermining and enhancing effects of reward on intrinsic motivation. In J. M. Levine, & M. C. Wand (Eds.) Teacher and student perceptions: Implications for teaching. Hillsdale, NJ: Erlbaum.

Rosch, G. D. (1980). Videotext and the publishing industry. Vital Speeches, 47, 98-100.

Rothkoph, E. Z. (1970). The concept of mathematics as instrumental learning activities. Instructional Science, 3, 51-74.

Salomon, G. (1984). Television is "easy" and print is "tough": The differential investment of mental effort in learning as a function of perceptions and attributions. Journal of Educational Psychology, 74(4), 647-658.

Snow, R. E. (1980). Aptitude, learner control, and adaptive instruction. Educational Psychologist, 15(3), 151-158.

Wittrock, M. C. (1974). Learning as a generative process. Educational Psychologist, 11, 87-95.